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BULLETIN DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE
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Observations upon some specimens of the genus *Periclimenaeus* Borradaile (Decapoda Natantia, Pontoniinae) originally described by G. Nobili

by A. J. Bruce *

Résumé. — Les spécimens attribués par Nobili à *C. rhodope* et à *C. hecate*, et placés maintenant dans le genre *Periclimenaeus* Borradaile ont été réexaminés. Il est nécessaire d'attribuer les spécimens de *P. rhodope* à trois, peut-être quatre espèces de *Periclimenaeus* : *P. rhodope* s. str., *P. arabicus* (Calman), *P. djiboutensis* Bruce et *Periclimenaeus* sp.

Les spécimens types de *P. djiboutensis* déjà décrits sont considérés comme faisant partie du matériel de Nobili. *P. hecate* est distinct de *P. tridentatus* (Miers) et le spécimen identifié par Nobili comme une « anomalie » de *P. hecate* est décrit comme une nouvelle espèce, *P. nobilii*. Un lectotype est désigné pour *P. rhodope* (Nobili) et une clé est fournie pour l'identification provisoire de *P. tridentatus* (Miers) et des espèces proches.

In 1904, Nobili briefly described some new Pontoniinid shrimps collected from Djibouti by H. Coutière. They were then placed in the genus *Coralliocaris* Stimpson, subgenus *Onycocaris* Nobili. In 1906, another specimen from the Persian Gulf, collected by Bonnier and Pérez, was referred to the same genus. Subsequently, also in 1906, Nobili provided a more detailed and illustrated report upon these specimens as *Coralliocaris* (*O.*) *rhodope* and *C. hecate*. Later, Holthuis (1952) referred a further single specimen from Indonesia to Nobili's *C. rhodope*, but transferred it from *Coralliocaris* to the genus *Periclimenaeus* Borradaile. *C. hecate* was similarly transferred to *Periclimenaeus*.

These specimens have been preserved in the collections of the Muséum national d'Histoire naturelle, Paris, and through the kindness of Dr J. Forest, were made available for the present examination.

The specimens are unfortunately incompletely preserved and more than half the complement of second pereiopods is lacking and very few of those preserved are attached to the bodies. Very few ambulatory pereiopods have been preserved.

The collection consists of six tubes, four labelled as *Coralliocaris* (*Onycocaris*) *rhodope* types, one as *Coralliocaris hecate* and one as " ? anomalie de *Coralliocaris hecate* ". The tube with most of the specimens of *C. rhodope* was found to consist of several readily separable species, the details of which are provided later, together with some information upon other related species.

* *East African Marine Fisheries Research Organization, Zanzibar.*
Present address : *26 St. Peter's Grove, Canterbury, Kent, Great Britain.*

According to Nobili's 1906 publications there were fourteen specimens of *C.* (*O.*) *rhodope* and two of *C. hecate* from the Red Sea, and one specimen of *C.* (*O.*) *rhodope* from the Persian Gulf. An additional specimen from the Red Sea, identified by Nobili, but apparently to which no published reference was made, was also examined.

NOTES ON THE SPECIMENS

1. **Periclimenaeus rhodope** (Nobili)
(Fig. 1-2, 3 A-B, 7 A-B)

Coralliocaris (*Onycocaris*) *rhodope* Nobili, 1904 : 233.

Material examined : 2 ♂, 2 ovigerous ♀, Djibouti, coll. H. Coutière.

Description

Four out of the fourteen specimens originally placed by Nobili to this taxon are considered to belong to the species referred to in his description. They consist of one male, with both second pereiopods still attached, together with another male and two ovigerous females.

In the males there are 9/2 and 6/0 rostral teeth and in the females 7/0 and what could be interpreted either as 9/1 or 10/0. In all specimens the first rostral tooth is just at or behind the posterior orbital margin. In the four specimens the rostrum shows considerable variation in dentition, and depth of the lamina, but in all is more or less horizontal. The supra-orbital spines are small and conical. The orbit is obsolescent.

The antennae are remarkable particularly for the very great size of the antero-lateral spine of the scaphocerite, which far exceeds the rounded anterior margin of the lamina, and the acutely produced disto-lateral angle of the proximal segment of the antennular peduncle, which extends well beyond the anterior margin of the intermediate segment. The eyes are moderately slender with the cornea oblique and narrower in diameter than the stalk.

The first pereiopod is slender with the carpus and merus subequal. The chela is also slender, about 0.6 of the length of the carpus. The palm in the female is 3.8 as long as wide and 2.5 times the length of the fingers, which are slender, with simple cutting edges and small pointed hooked tips. In one male both second pereiopods were still attached and can therefore be definitely attributed to this species. The chelae are markedly unequal and dissimilar. In the major chela the palm is broad and flattened, about 0.6 times as long as wide and tapering distally. The median and lateral margins bear numerous small conical tubercles and a few short setae. The dactylus is stout with the tip strongly curved distally. The molar process is rather small and only very vaguely demarkated, particularly distally, where it merges with the cutting edge. The dactylus is about 0.4 of the length of the palm and is at least twice as long as broad. The fixed finger is curved, with a single small blunt tooth on the proximal half of the dorsal border. The tips of the dac-

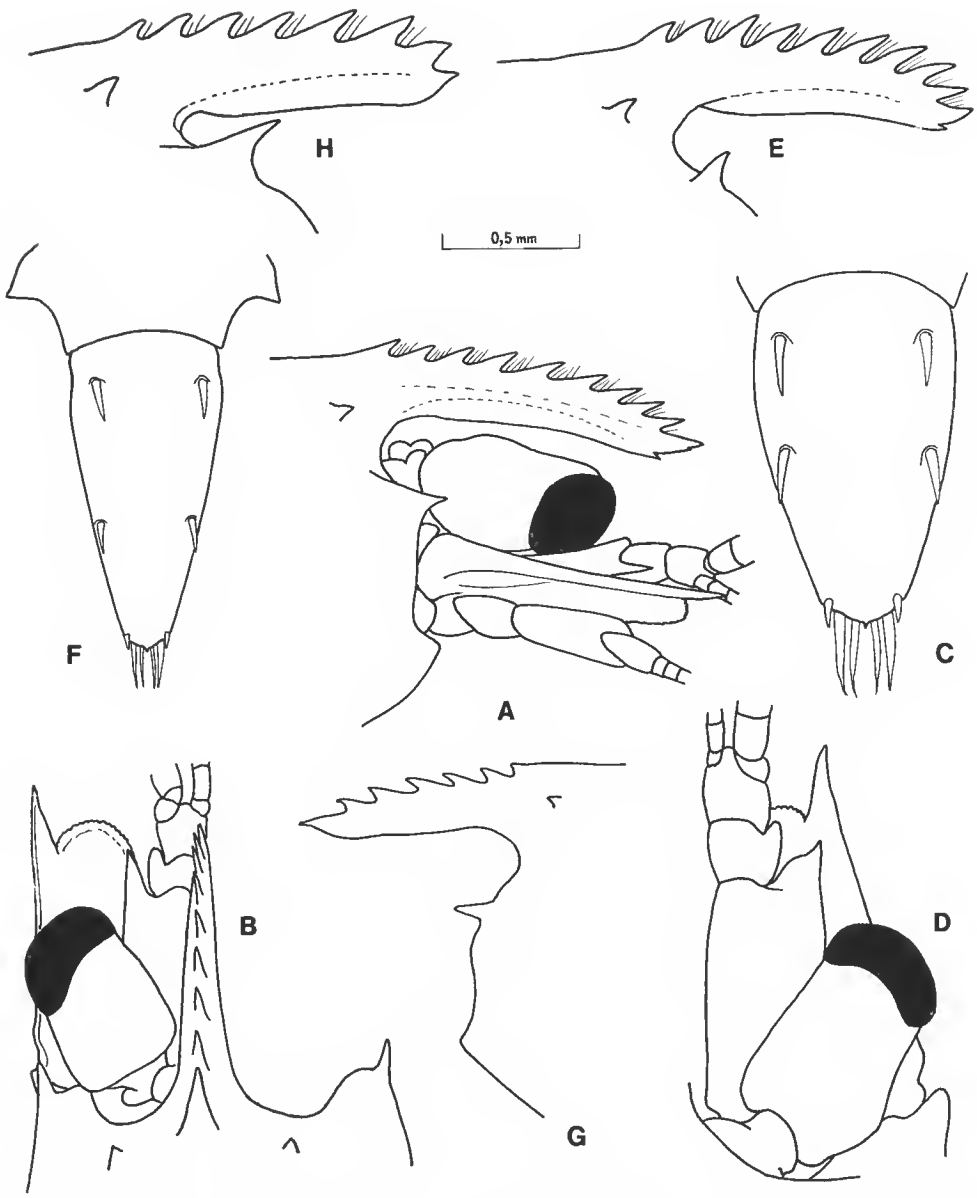

Fig. 1. — *Periclimenaeus rhodope* (Nobili). Lectotype, male : A, anterior carapace, eyes and antennal peduncles, lateral view ; B, dorsal view ; C, telson. — Paralectotype, female : D, antennal peduncle, eye and scaphocerite ; E, rostrum ; F, telson ; G, anterior carapace and rostrum, male ; H, rostrum, female.

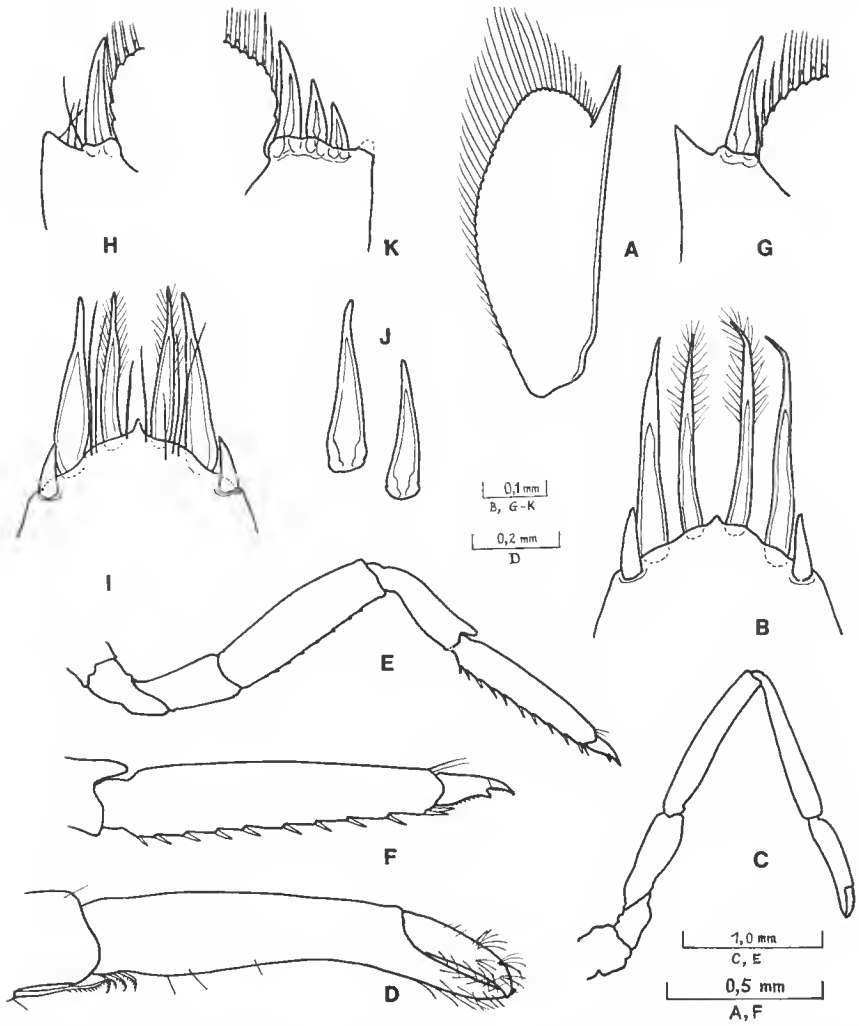

Fig. 2. — *Periclimenaeus rhodope* (Nobili). Lectotype, male : A, scaphocerite ; B, posterior telson spines ; C, first pereiopod ; D, chela of first pereiopod ; E, third pereiopod ; F, propod and dactylus of third pereiopod ; G, disto-lateral angle of exopod of uropod. — Female : H, disto-lateral angle of exopod of uropod ; I, posterior telson spines ; J, dorsal telson spines. — Male : K, disto-lateral angles of exopod of uropod.

tyls are smoothly continuous with the cutting edges and are poorly demarkated. The minor chela is essentially similar but smaller, the whole chela being the length of the palm of the larger chela. The fingers are relatively longer and slimmer and distinctly exceed half the length of the palm. The borders of the palm are spinulate. The cutting edge of the dactylus is sinuous and of the fixed finger broadly concave, with a small triangular tooth on the proximal third of the edge. The tips of the fingers are again feebly demar-

kated from the cutting edges. The carpus is short and stout, broadly expanded distally and with numerous small acute tubercles over the dorso-lateral aspect. The merus bears several similar small acute tubercles (4-6) on the ventral border and a few minute tubercles are also present on the ischium.

The ambulatory pereiopods bear a characteristic dactylus which is distinctly biunguiculate with minute denticles along the ventral margin of the unguis and the corpus proximal to the accessory spine. The dactylus is 2-2 ½ times longer than the basal width and that of the third pereiopod is more slender than the fifth. The corpus has 4-6 ventral teeth and the unguis 5-6. In one male the tip of the unguis appears to be articulated. The ventral border of the propod is strongly spinulate with 10 well developed spines. The carpus is unarmed and the ventral margin of the merus bears a series of small acute tubercles only.

The uropods are broad with entire unarmed lateral borders to the exopods but the disto-lateral angle is acutely produced and may be assymetrical, and bears from 1-3 strong spines.

The telson is narrower in the female than in the male, 2.1 and 1.8 times longer than wide respectively. The two pairs of dorsal spines are well developed, subequal in the male, the posterior slightly shorter than the anterior in the female. In the female the anterior spines are closer to the anterior margin of the telson and the posterior spines are more posteriorly situated than in the male, in which they are at about the middle of the telson length. The lateral posterior spines are short and stout and dorsally situated. The tips of the intermediate and submedian spines all reach to about the same level posteriorly. They are distinctly more slender in the male than in the female. The distal halves of the submedian spines are plumose.

Remarks

Periclimenaeus rhodope is known only from Djibouti. The specimen referred to this species by Holthuis (1952) has been separated as *P. holthuisi* by Bruce (1969). The main difference is that the disto-lateral spine of the scaphocerite greatly exceeds the lamina in *P. rhodope* (Nobili). Other differences are that the ventral borders of the dactyls of the ambulatory pereipods are spinulate, whereas in *P. holthuisi* they are crenulate, including the accessory spine, and there is no post-rostral tooth situated behind the level of the orbital margin, a feature that is present in *P. holthuisi*.

It must be emphasized that only the male and one female can be attributed with certainty to Nobili's species as only in these two specimens was one of the diagnostic ambulatory pereiopods still attached. The other two specimens that have been here identified as belonging to this species cannot with complete certainty be distinguished from *P. arabicus* (Calman) as no distinctive features could be found in rostrum, carapace, uropods or telson. The anterior border of the lamina of the scaphocerite is rounded in *P. rhodope* but more truncate in *P. arabicus* and this feature appears to separate the two species.

The male specimen is designated as the lectotype of *Periclimenaeus rhodope* (Nobili). The specimen is moderately well preserved, with all pereiopods except the right fourth pereiopod.

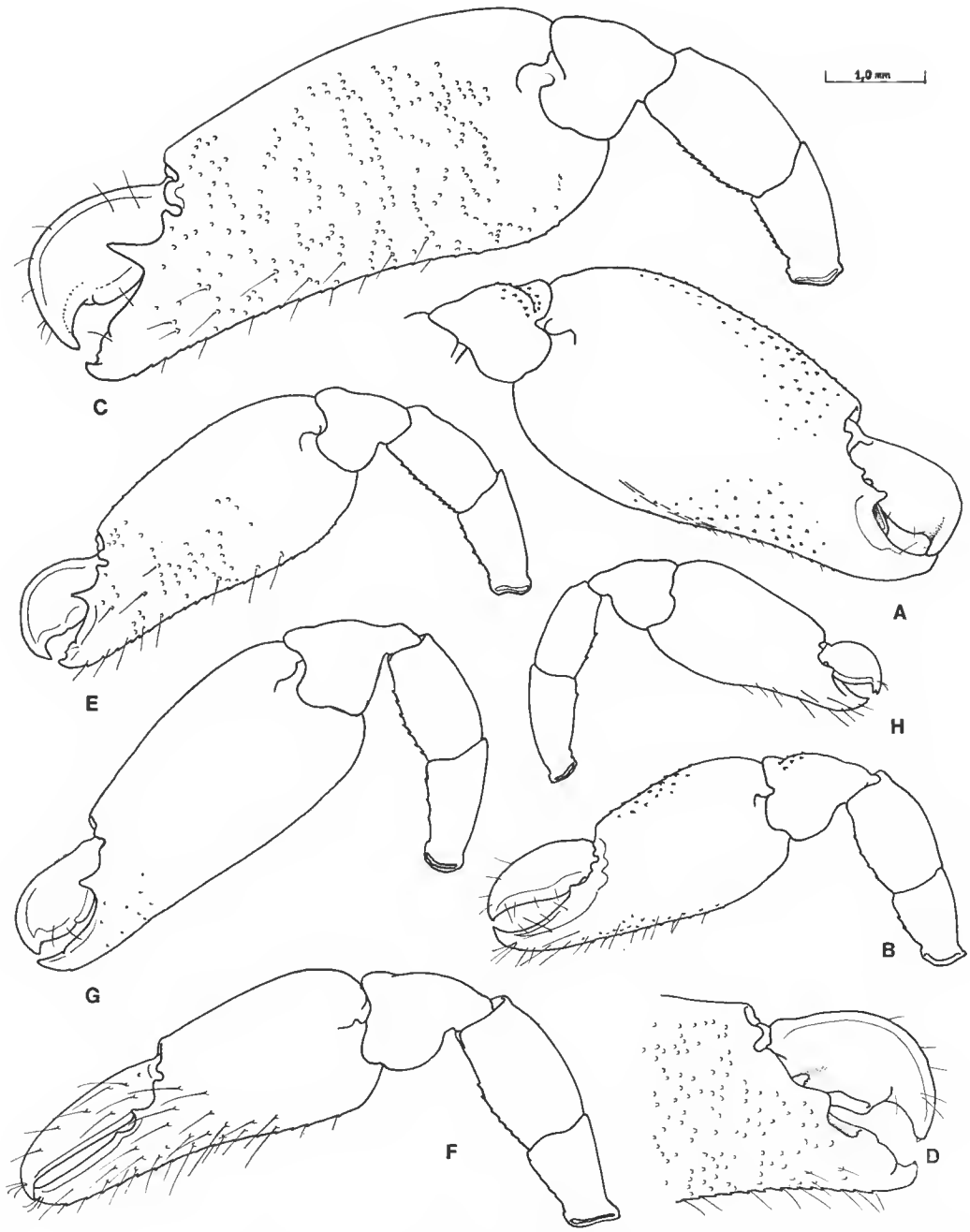

Fig. 3. — Second pereiopods of *Coralliocaris* (*O.*) *rhodope* « types ». *Periclimenaeus rhodope* (Nobili) s. str., lectotype ♂ : A, carpus and chela of major second pereiopod; B, minor second pereiopod. — *Periclimenaeus arabicus* : C, major second perciopod ; D, fingers of major chela ; E, major second pereiopod ; F, minor second pereiopod. — *Periclimenaeus djiboutensis* Bruce : G, major second pereiopod; H, minor second pereiopod.

2. **Periclimenaeus arabicus** (Calman)
(Fig. 3, G-F ; 4-6 ; 7, C-H)

Periclimenes (*Periclimenaeus*) *arabicus* Calman, 1939 : 210-211, fig. 4.

Materiel examined : 2 ♂, 2 ovigerous ♀, Djibouti, 1906, coll. H. Coutière.

Description

Four specimens are referred to this species. In all specimens one or more of the characteristic ambulatory pereipods is still attached to the body, thus enabling the specimens to be separated from the *P. rhodope* specimens.

None of the four specimens have any of the second pereiopods attached. Calman (1939) has provided a figure of the major second pereiopod, and Dr R. W. Ingle has kindly provided further information concerning the holotype, so that it is felt that three of the second detached pereiopods can be allocated to these specimens with a considerable degree of confidence. The relatively long and slender setose fingers of the minor second pereiopod of the holotype, particularly show a close resemblance to the present specimens.

One male and the smaller ovigerous female clearly resemble each other, particularly in the form of the rostrum, telson and uropods. The second male and larger ovigerous female show differences in these parts and should possibly be referred to a separate but closely related species. This step is not felt to be justified in view of the absence of any associated second pereiopods.

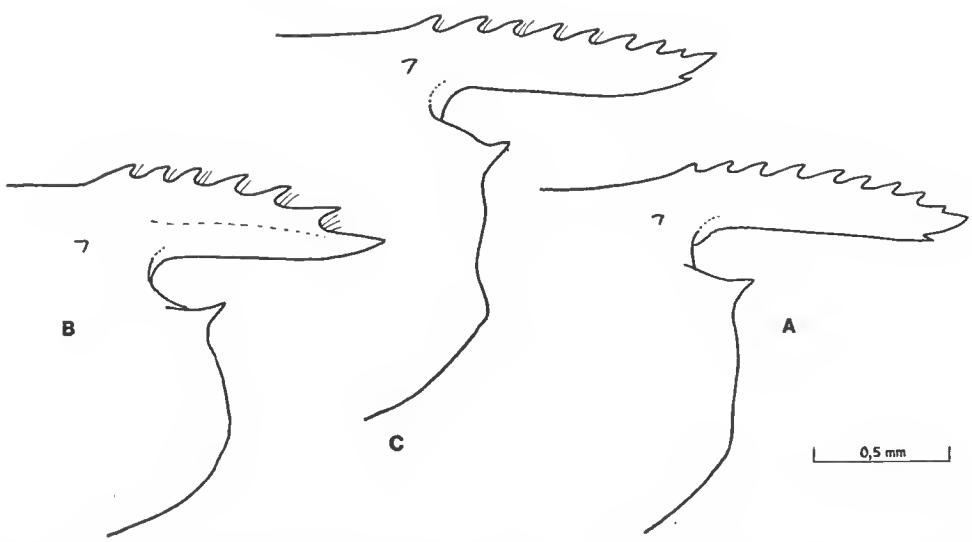

Fig. 4. — *Periclimenaeus arabicus* (Calman), anterior carapace and rostrum : A, male ; B, smaller ovigerous female ; C, larger ovigerous female.

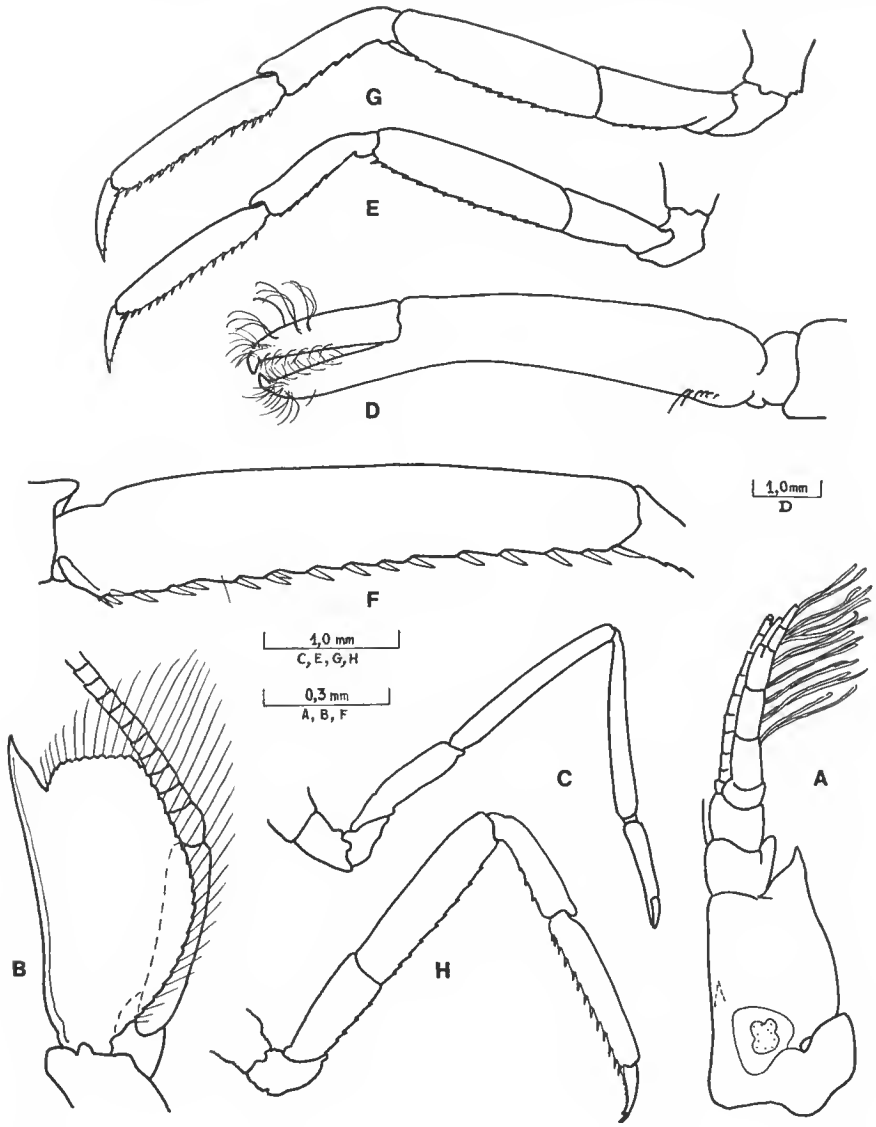

Fig. 5. — *Periclimenaeus arabicus* (Calman) : A, antennule ; B, antenna. — Small ovigerous female : C, first pereiopod ; D, chela of first pereiopod ; E, third pereiopod ; F, propod of third pereiopod. — Larger ovigerous female : G, third pereiopod. — Male : H, third pereiopod.

In the first pair, the male's rostrum has nine rather small acute teeth dorsally with a single small distal ventral tooth, and the ventral border is straight. The posterior tooth is just situated on the carapace. The rostrum reaches to the middle of the distal segment of the antennular peduncle. The rostrum in the female is basically similar but there are

eight dorsal teeth and the ventral border is convex. In the larger female of the second pair the rostrum is shorter with only six dorsal teeth and without a ventral tooth. The teeth are slightly larger and more acute, and the first tooth is situated slightly more posteriorly. The rostrum of the male is similar. In all specimens a small acute conical supraorbital tubercle is present.

The basal segment of the antennule is broad with a large acute disto-lateral process and a short, broad stylocerite. A very strong medial ventral spine is present. The basicerite is unarmed laterally. The scaphocerite is broad, with the lamina almost twice as long as wide and the anterior margin truncated rather than rounded. The disto-lateral spine is very well developed and far outreaches the lamina.

The first pereiopod of the small female is slender, with the merus slightly longer than the carpus, which is 1.75 times the length of the chela. The chela is slender with medially curved fingers. The palm is 4.4 times longer than wide, and tapers slightly distally. The fingers are 0.43 of the palm length, slender with strong hooked tips and straight cutting edges.

The second pereiopods are all detached. The major second pereiopods attributed to these specimens are robust. The palm of the chela is subcylindrical, slightly flattened, tapering slightly distally, and about 1.7 times longer than wide. The surface is covered with numerous small tubercles in the larger example but these are less marked in the smaller. The fingers are short and stout, about 0.45 of the length of the palm. The dactylus is moderately compressed and has a strongly convex outer margin, with an acute strongly hooked tip. The molar process is large and distinct from the anterior cutting edge, and fits into deep fossa on the proximal cutting edge of the fixed finger. The cutting

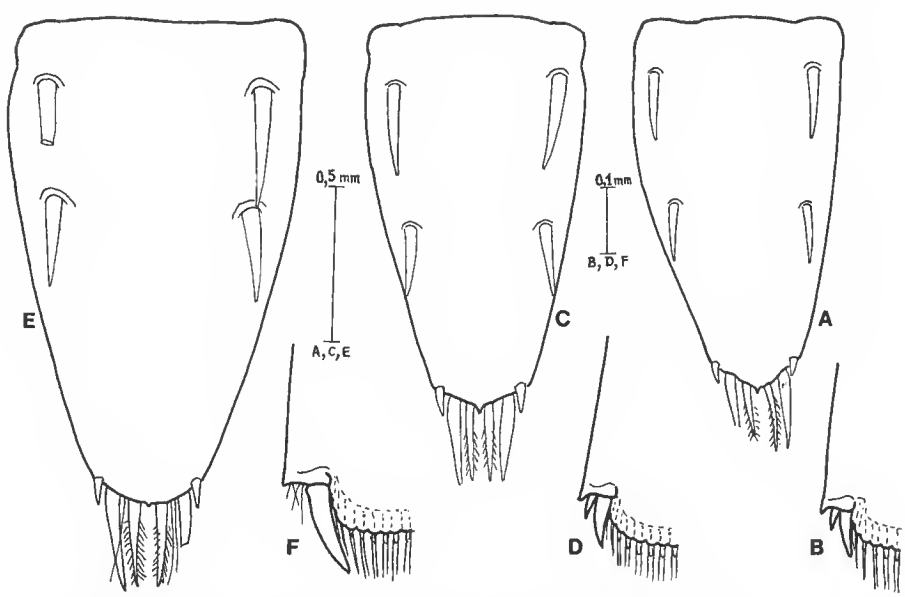

Fig. 6. — *Periclimenaeus arabicus* (Calman), telson and disto-lateral angle of exopod of uropod : A-B, male ; C-D, smaller ovigerous female ; E-F, larger ovigerous female.

edges of both fingers are short and blunt. The dorsal proximal margin of the fixed finger bears a long acute process and a short blunt lobe is present in a similar position on the ventral aspect. The carpus is short and stout and devoid of spines or tubercles. The merus and ischium are robust, with numerous small acute tubercles along the ventral borders.

The minor second pereiopod is densely tuberculate but bears numerous long setae on its distal dorsal aspect. The palm is 1.5 times longer than broad and tapers strongly distally. The fingers are about 0.85 of the length of the palm. The dactylus is compressed and slender and about 4 times longer than the greatest width. The tip is strongly hooked and the cutting edge long, straight and entire. The fixed finger is similar but bears a small tooth proximally, separated by a semi-circular gap from a larger tooth situated at the level of the proximal end of the dactylar cutting edge. The carpus, merus and ischium are similar to those of the major second pereiopod.

The third pereiopods are represented in each specimen and show no essential differences. The ventral margin of the propod is strongly spinulate in all, with a tendency to develope a double row of spines proximally. The carpus bears a few small conical tubercles ventrally. Many acute tubercles are present along the ventral border of the merus and a few are also present on the ischium. The fourth and fifth pereiopods are much less strongly spinulate. In the fourth, the merus has only five ventral spines and in the fifth only two.

Only the male of the first pair of specimens has the third to fifth pereiopods preserved with the dactyls, which are long and slender and at least four times longer than the basal width. In this pair of specimens the ventral border bears a series of small teeth, 3-7 in number, situated on the proximal two thirds or one half, and best developed on the third pereiopod. The distal ventral extremity of the corpus bears a small acute accessory spine. The unguis is distinctly demarkated from the corpus, curved, with a series of 7-9 small acute teeth along the ventral margin. In the larger ovigerous female, the unguis is similar but the ventral teeth of the corpus are more numerous, 9 in number, acute posteriorly and blunter distally, extending along the whole ventral border. The distal ventral angle is bluntly produced but may have been damaged.

The uropods are broad. The protopodite is not produced posteriorly and the lateral margin of the exopod is entire, without spines or denticulations. In the first pair of specimens the disto-lateral angle is acutely produced with a small lateral and a larger median spine on both sides in male and female. In the second pair of specimens the disto-lateral angle is acutely subrectangular with a single large spine on both sides.

In the first pair of specimens the telson is moderately broad, about 1.7-1.8 times longer than wide, and tapering strongly posteriorly. In the second pair of specimens the posterior margin has a distinct acute median process but in the larger female of the second pair this is very much reduced. Two pairs of large dorsal spines are present, all situated on the anterior half of the telson, with the anterior pair slightly larger than the posterior pair. The posterior spines are situated at 0.36 of the telson length and are overlapped by the tips of the anterior spines. In the second pair, the posterior spines are at 0.48-0.53 of the telson length and are remote from the tips of the anterior spines. The usual three pairs of posterior telson spines are present, with the small lateral spines slightly dorsally situated. The submedian spines are coarsely plumose and relatively stout.

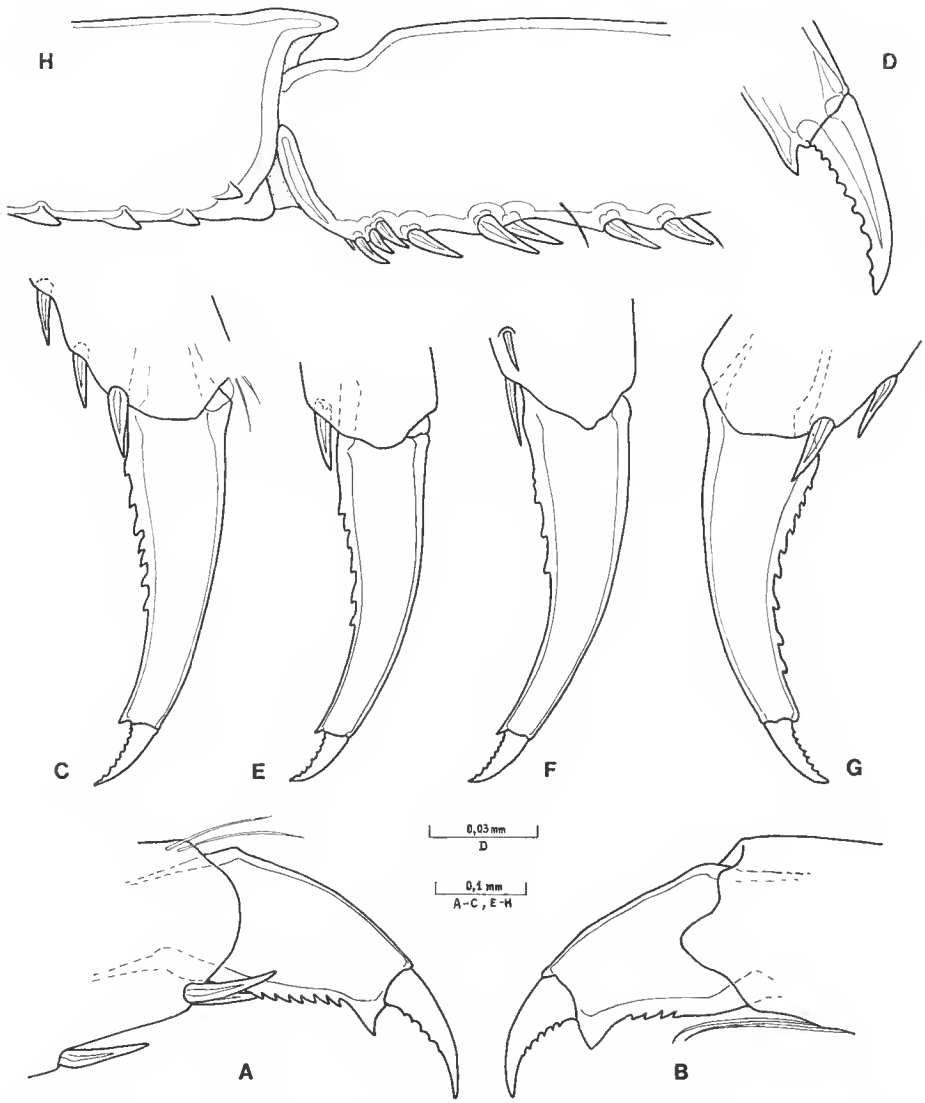

Fig. 7. — *Periclimenaeus rhodope* (Nobili) : A, dactylus of third pereiopod ; B, dactylus of fifth pereiopod. — *Periclimenaeus arabicus* (Calman), male : C, dactyl of third pereiopod ; D, unguis ; E, dactylus of fifth pereiopod; F, dactylus of fifth pereiopod. — Female : G, dactylus of third pereiopod ; H, carpo-propodal joint of male third pereiopod.

Remarks

In view of the mixed nature of Nobili's *Periclimenaeus* material, it seems probable that the two pairs of specimens and the larger ovigerous female are of separate origin, probably from different host sponges. The first pair closely resemble Calman's description of *P. arabicus* in the telson but the second pair agrees more closely in the form of the

rostrum and the uropods. The dactylus of the third pereiopod shows slight differences in all specimens, which may be possibly only due to individual rather than specific variation. There is a very close similarity to the dactylus of the holotype (fig. 15, A). The two pairs may represente distinct species but without the associated second pereiopods no conclusion can be reached.

Periclimenaeus arabicus has not been reported since its original description and is known only from the South Arabian coast. *P. ohshimai* Fujino (1967) is very closely related and appears to differ only in that the posterior dorsal telson spines are about half the length of the anterior.

3. **Periclimenaeus djiboutensis** Bruce
(Fig. 8 ; 9 ; 13 A-D)

Periclimenaeus djiboutensis Bruce, 1970 : 307-308.

Material examined : 1 ♂, 2 ovigerous ♀, Djibouti, 1906, coll. H. Coutière.

Description

The three specimens are all incomplete with no ambulatory pereiopods and most of the mouthparts missing. None of the second pereiopods are attached, but two isolated detached second pereiopods are considered to belong to these specimens. The remaining mouthparts have not been examined.

The male and one of the ovigerous females have the rostrum intact. In both, it is well developed, strongly compressed and ventrally inclined. The ventral border is straight and without teeth. The dorsal border is gently convex with nine long slender dorsal teeth in the male and ten in the female. All dorsal teeth are situated well in advance of the posterior orbital margin. The tip of the rostrum is acute and reaches to the middle of the intermediate segment of the antennular peduncle.

Supra-orbital spines are completely absent. The orbit is obsolescent but the antennal spine is long and slender, particularly in the female where it appears to be rather dorsally orientated. The anterior margin of the branchiostegite is deeply notched and the antero-ventral angle is produced and rounded.

The proximal segment of the antennular peduncle is very broad basally, about 0.8 of the length of the segment. It tapers strongly distally, where the lateral border is concave, and the disto-lateral angle is strongly produced to the middle of the intermediate segment, and is acutely pointed. The stylocerite is remote from the lateral margin of the segment, slightly exceeding the middle of the length of the segment and is very acutely pointed. The medial border bears a small ventral spine at half its length. The upper flagellum consists of five fused segments, with the shorter ramus consisting of two segments only in the male specimen.

The antenna has a robust basicerite without any lateral spine. The dorso-lateral aspect bears a large rounded lamina that fits into the emargination of the anterior border of the branchiostegite. The carpocerite is elongated and flattened and reaches to the base

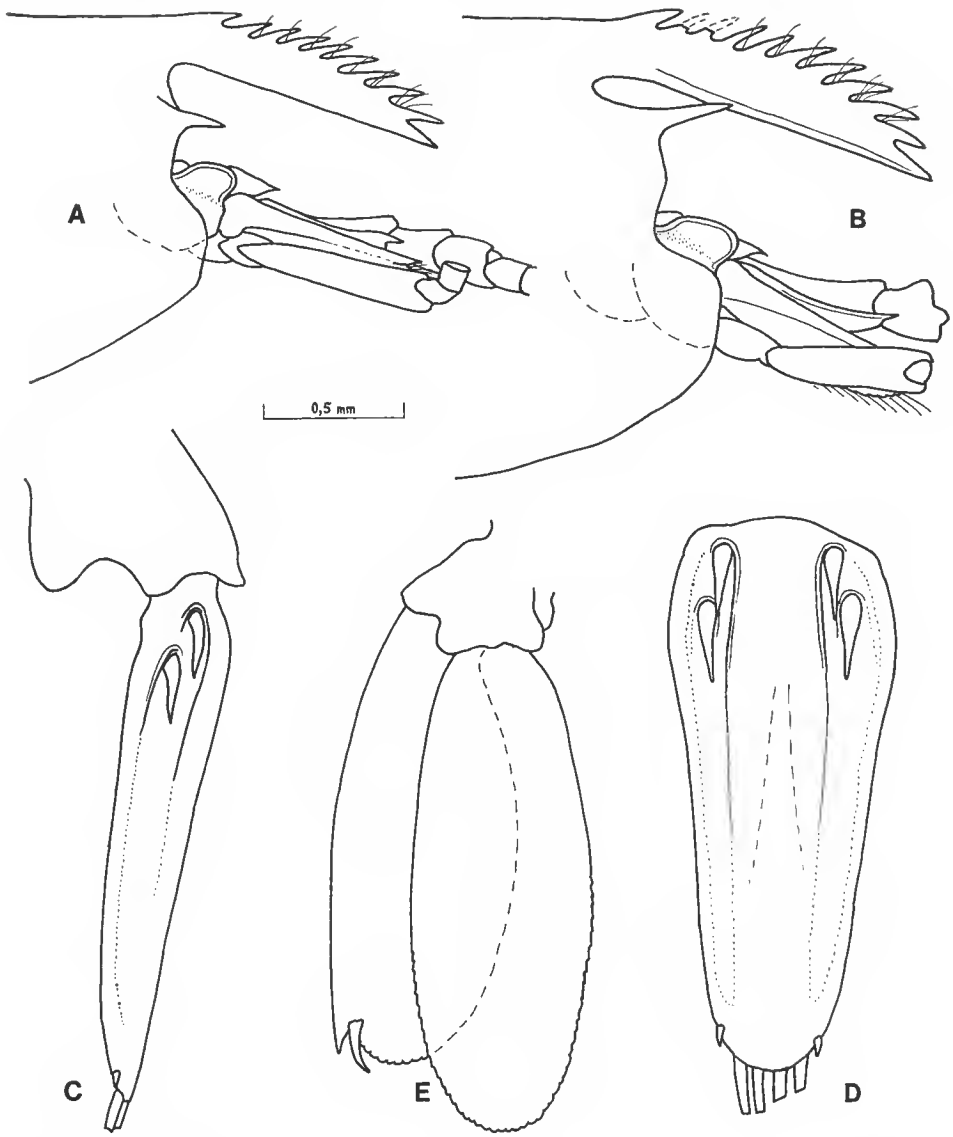

Fig. 8. — *Periclimenaeus djiboutensis* Bruce, anterior carapace, rostrum and antennal peduncles : A, male ; B, female. — Larger ovigerous female : C, telson, lateral view ; D, telson, dorsal view ; E, uropod.

of the disto-lateral spine of the scaphocerite. The lamina of the scaphocerite is about 2.6 times longer than wide in the female, of relatively uniform width with a bluntly rounded anterior margin that is slightly exceeded by the well developed acute disto-lateral spine.

A single detached first pereiopod, probably from the smaller ovigerous female is still

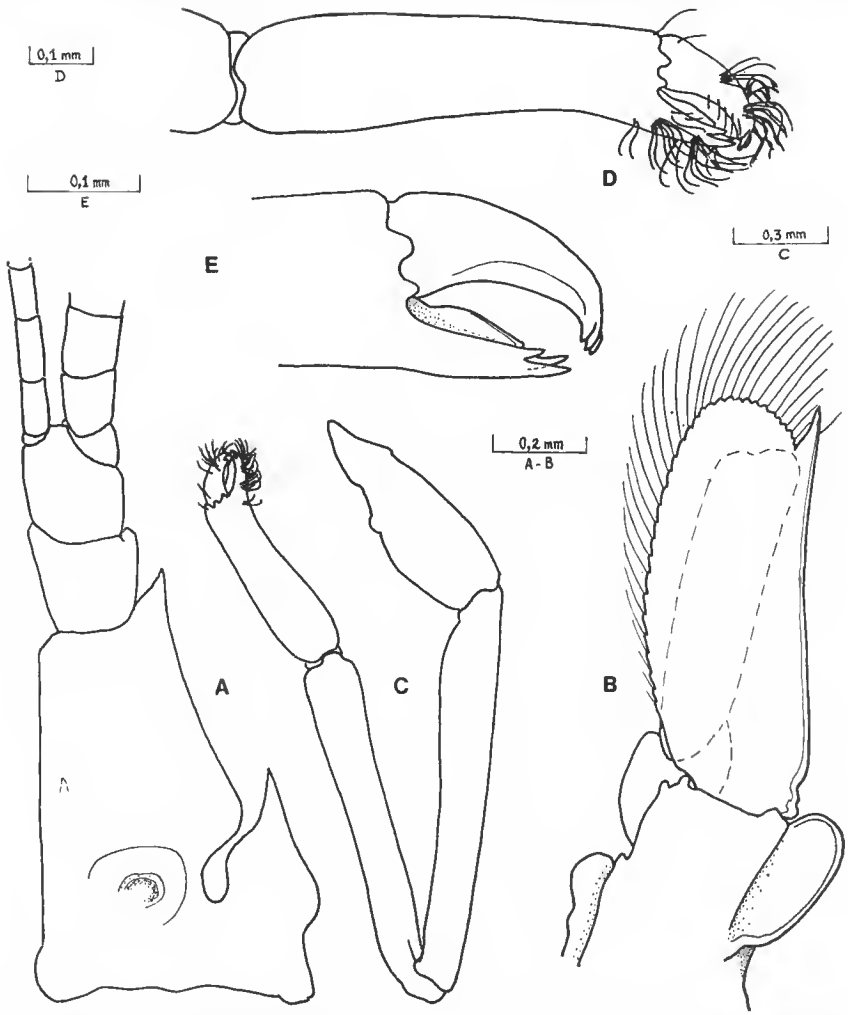

Fig. 9. — *Periclimenaeus djiboutensis* Bruce, female : A, antennule ; B, antenna. — Male : C, first pereiopod ; D, chela of first pereiopod ; E, fingers of chela of first pereiopod.

present. The palm of the chela is subcylindrical, tapering slightly distally and about 3.7 times longer than the greatest width. The fingers are short, less than one third of the length of the palm, and with numerous groups of coarse setae. The fingers are subspatulate and taper distally, ending in a group of acute interdigitating teeth. The teeth on the dactylus are shorter and stouter and slightly curved compared to those on the fixed finger, which are longer straighter and more slender. The margins of the opposing edges of the fingers are entire. The carpus is moderately slender, nearly seven times longer than wide distally, and equal to about 0.9 of the length of the merus, and 1.6 times the length of the chela.

Two second pereiopods are attributed to this species and appear to constitute a natural

pair of appendages, being very similar in texture and colouration and were found in the same tube. The major second pereiopod is robust with a subcylindrical, slightly flattened and distally tapering palm. The palm is about 1.6 times longer than wide and is almost completely devoid of tubercles and setae. The fingers are equal to half the length of the palm. The dactylus is compressed, feebly upcurved, and twice as long as wide. The tip is broadly hooked and the anterior cutting edge is convex, with a well developed molar process proximally. The fixed finger is relatively elongated and slender, exceeding the tip of the dactylus. The tip is acute and not hooked. The cutting edge is entire with a proximal fossa. The dorsal border bears a large blunt process proximally. The carpus is short and unarmed. The merus bears several acute tubercles along the ventral border and a few small tubercles are also present on the ischium.

The chela of the minor second pereiopod is much smaller than the major. The palm is smooth, 0.6 of the length of the palm of the major chela and 1.5 times longer than wide, tapering distally, with several long setae along the ventral margin. The dactylus is about 0.4 of the length of the palm, compressed, with an evenly semi-circular outer border and a strongly hooked bidentate tip. The cutting edge is entire and smoothly convex. The fixed finger is short and broad, acute distally but without a hooked tip. Proximally a distinct groove is present, into which the cutting edge of the closed dactylus fits. A small blunt process is also present proximally on the dorsal border. The carpus, merus and ischium are similar to the major second pereiopod but less noticeably tuberculate.

The uropods have the disto-lateral angle of the protopodite unarmed. The lateral border of the exopodite is convex, without spines or teeth and ends in a strong acute distal process with a large strongly hooked spine medially, which extends beyond the posterior margin of the lamella. The endopod distinctly exceeds the exopod. The telson is rather narrow, 2.5 times longer than wide anteriorly and strongly concave ventrally. The lateral margins converge slightly posteriorly to a broadly rounded posterior margin. The two pairs of dorsal spines are all situated on the anterior fifth of the telson length and arise from the anterior part of a well marked longitudinal dorso-lateral groove that extends along most of the length of the telson. The anterior spines arise more closely to the midline than the posterior spines, at about 0.08 of the telson length and the posterior spines at 0.15 of the length. The posterior spines are stout, tapering strongly distally, equal to about 0.15 of the telson length. The anterior spines are slightly shorter. Both pairs of spines are slightly sinuous in lateral view. The lateral posterior spines are short and small and situated slightly more dorsally than the other spines. In the larger ovigerous female they are also separated by a distinct gap from the intermediate spines, which are stout and about equal to 0.2 of the telson length. The submedian spines are similar to the intermediate spines but slightly more slender and are without setules.

Remarks

The original description of *Periclimenaeus djiboutensis* was based upon three specimens found in the collections of the Museum, labelled " *Onycocaris* sp., Djibouti ", and without any further indication of their origin. In his 1906 description of *Coralliocaris* (*O.*) *rhodope*, Nobili mentions that he had fourteen specimens from Djibouti. The present material under study, clearly labelled as Nobili's material, consists of twelve specimens of which

three are *P. djiboutensis*. It seems highly probable that the three type specimens of *P. djiboutensis* are also part of Nobili's matorial that had become separated from his labelled specimens. However, this gives a total of fifteen specimens from Djibouti, one more than Nobili stated that he had.

The specimens here reported upon, although incomplete, agree closely with the original description of the type specimens, which also lacked several appendages. To augment the original description, detail is provided of the second pereiopods of this species. The minor second pereiopod described in the preliminary description is now considered to have belonged to one of the *P. arabicus* specimens. Unfortunately, the only ambulatory pereiopod is no longer extant.

In the original description of this species, it was considered most closely related to *Periclimenaeus fimbriatus* Borradaile. This relationship is no longer considered correct. The type specimens of *P. fimbriatus* have been reexamined and the lateral margin of the exopod of the uropod is spinulate (fig. 15, B). *P. djiboutensis* now appears to occupy a rather isolated systematic position in the genus *Periclimenaeus* but on the available information, appears to be most closely related to *P. hebedactylus* Bruce.

4. **Periclimenaeus** sp.
(Fig. 10)

Material examined : 1 ♂, Djibouti, 1906, coll. H. Coutière.

Remarks

The single specimen is without second pereiopods and ambulatory pereiopods. The disposition of the dorsal telson spines exclude *P. djiboutensis* from consideration and the form of the anterior margin of the scaphocerite appears to resemble that of *P. rhodope* rather than *P. arabicus*. The first pereiopod is also more similar to *P. rhodope*. The rostrum shows small differences from the *P. rhodope* specimens that prevent this specimen being referred to that species with any certainty. The rostrum is more depressed and the first dorsal tooth is situated in advance of the posterior orbital margin and its posterior border is continuous with the dorsal midline of the carapace. The eight more anterior teeth are longer and more slender and acute and reach their greatest development at the sixth or seventh teeth. The ventral margin is feebly concave and without teeth. The supraorbital spine is small and acute.

The anterior margin of the lamina of scaphocerite is broadly rounded and the disto-lateral spine is long and slender with some small subterminal setae laterally, but extending beyond the lamina less than in *P. rhodope* specimens. The first pereiopod clearly resembles that of *P. rhodope* with the chela about 0.6 of the length of the carpus, but the chela is rather stouter and the fingers are equal to half the length of the palm.

The postero-lateral angles of the sixth abdominal segment are acutely produced, more markedly than in the specimens of *P. rhodope* or *P. arabicus*. The telson is slightly narrower than that of female *P. rhodope* or *P. arabicus* but is generally similar. The posterior dorsal telson spines are much smaller than the anterior spines, equal to about half

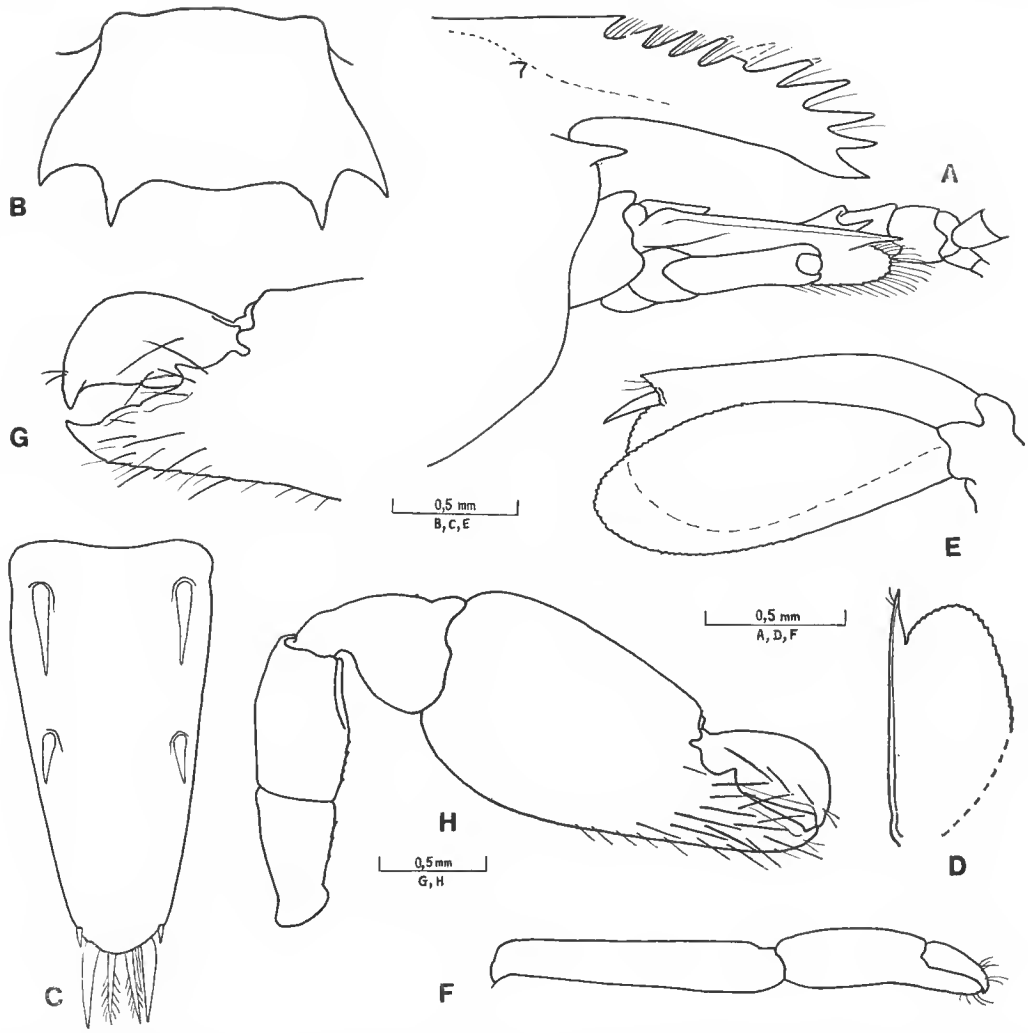

Fig. 10. — *Periclimenaeus* sp., female : A, anterior carapace, rostrum and antennal peduncles ; B, sixth abdominal segment ; C, telson ; D, scaphocerite ; E, uropod ; F, chela and carpus of first pereiopod ; G, fingers of chela of major second pereiopod ; H, minor second pereiopod.

their length, and are situated at 0.45 and 0.08 of the telson length respectively. The uropods closely resemble those of *P. rhodope*, with a single large disto-lateral spine and an acute disto-lateral angle on the exopod.

A pair of second pereiopods are provisionally attributed to this specimen, as they show slight differences from those of *P. rhodope* and *P. arabicus*. Tuberculation of the chela is lacking but numerous long slender setae are present on the dorso-ventral aspect of the distal palm and fixed finger and to a lesser extent on the dactylus. The fingers of

the minor second pereiopod are much shorter than in *P. arabicus* and have only a single acute tooth in the cutting edge. The proximal process on the dorsal aspect of the cutting edge of the major chela is also much less well developed. The carpus is glabrous dorsally in contrast to *P. rhodope* in which it is spinulate, and the cutting edges of the fingers of the minor second pereiopod are almost straight, with distinctly hooked tips, rather than concave, with feebly indicated tips.

5. **Periclimenaeus hecate** (Nobili)
(Fig. 11-12 ; 13, E)

Coralliocaris hecate, Nobili, 1904 : 232 ; 1906 : 58, pl. 3, fig. 2. — Borradaile, 1917 : 385.
? *Periclimenaeus tridentatus*, Holthuis, 1952 : 140-146, figs 63-65 (*partim*).

Material examined : 1 ♂, 1 ov. ♀, Djibouti, coll. H. Coutière.

Description

Nobili (1906) has provided a description and illustration of the male specimen, which is preserved in the attitude of his illustration. The second pereiopods are still attached to the body together with most of the ambulatory pereiopods.

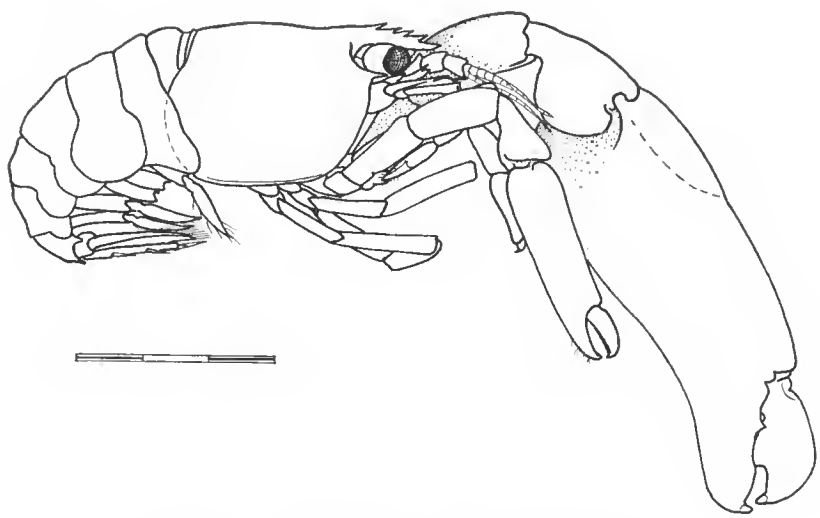

Fig. 11. — *Periclimenaeus hecate* (Nobili), male.

The rostrum of the female is similar to that of the male but five slender dorsal teeth, all well in advance of the carapace are present. In both, the ventral border is feebly convex and without teeth. There is no trace of any supra-orbital spine or tubercle.

The first pereiopods present no special features. The chela is slightly compressed, with

fingers slightly less than half the length of the palm, and 0.6 of the carpus. The carpus is very slightly longer than the merus.

The larger second pereiopod is smooth, subcylindrical, tapering slightly distally with the fingers short and stout, equal to 0.4 of the palm length. The cutting edge of the dac-

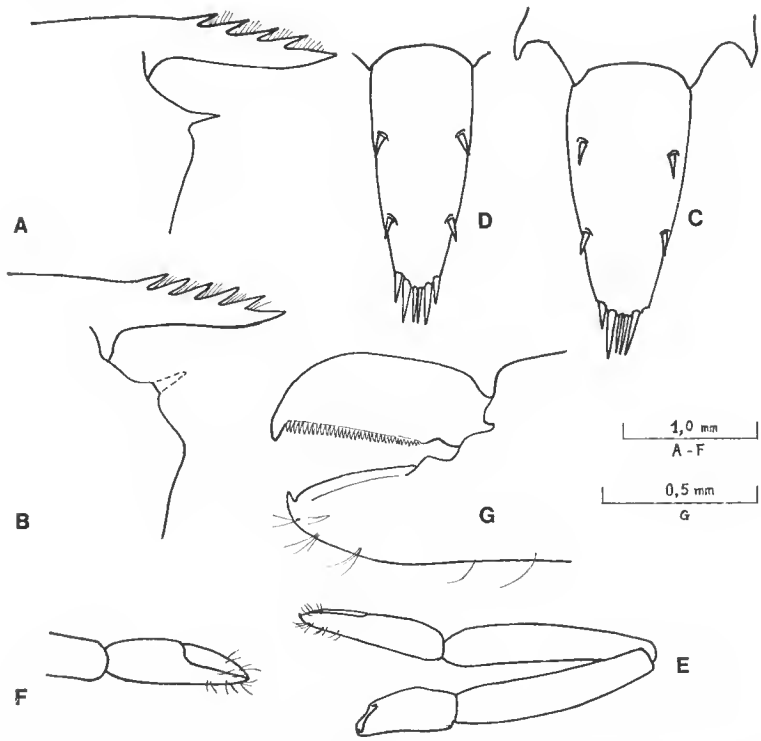

Fig. 12. — *Periclimenaeus hecate* (Nobili), types : A, anterior carapace and rostrum, male ; B, female ; C, telson, female ; D, male ; E, first pereiopod ; F, chela of first pereiopod ; G, fingers of minor second pereiopod.

tylus bears a stout molar process opposing into a fossa on the fixed finger. The carpus, merus and ischium present no special features. The minor second pereiopod is small, less than half the length of the major chela. The palm is smooth and subcylindrical and three times the length of the fingers, which are elongated. The dactylus is 2.6 times longer than wide, with the proximal two thirds of the outer margin subparallel to the cutting edge, which is straight, finely dentate throughout its length with over 40 acute teeth that diminish gradually in size proximally. The tip of the dactylus bears a large blunt tooth distally, discontinuous with the smaller series along the cutting edge. The fixed finger has the cutting edge entire, with a small blunt tooth proximally and a small acute tooth at the tip. The dactylus only barely exceeds the fixed finger.

The third pereiopod is stout, particularly the propod, which tapers distally and bears a short simple dactylus with a distinct margin but without proximal or distal accessory

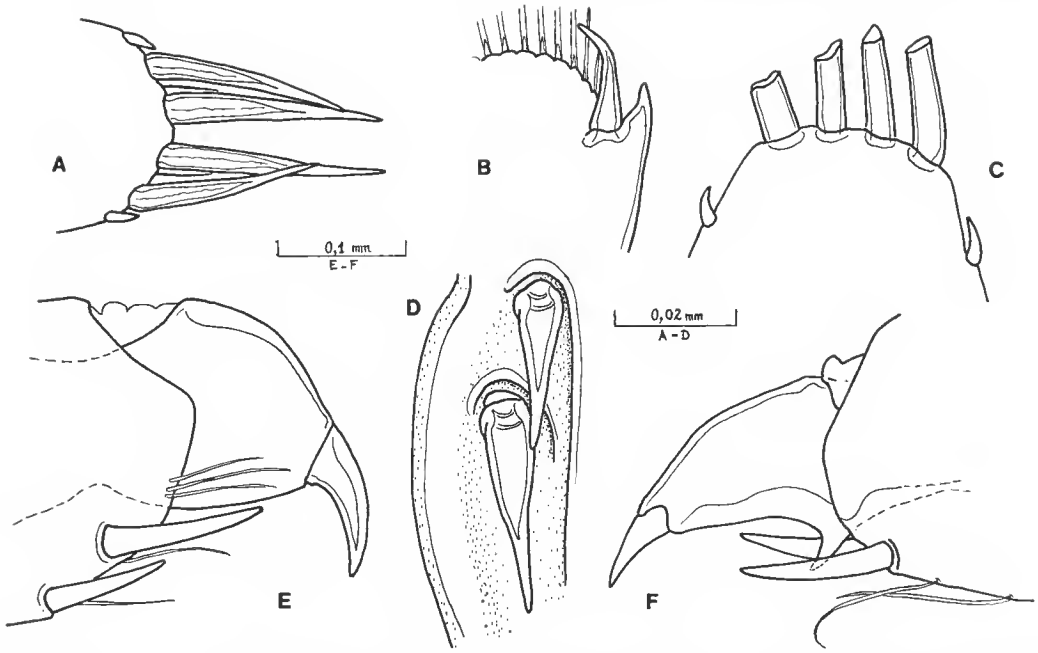

Fig. 13. — *Periclimenaeus djiboutensis* Bruce, small ovigerous female : A, terminal telson spines ; B, disto-lateral angle of exopod of uropod. Large ovigerous female : C, terminal telson spines ; D, dorsal telson spines. — *Periclimenaeus hecate*, type : E, dactylus of third pereiopod. — *Periclimenaeus nobilii* sp. nov., holotype : F, dactylus of third pereiopod.

spines. The distal end of the propod bears medial and lateral terminal spines and a ventral preterminal spine. The dactyls are similar on all pereiopods and in both sexes.

The caudal fan presents no unusual features. The dorsal telson spines are small and situated submarginally at thirds of the telson length.

Remarks

Periclimenaeus hecate was included in the synonymy of *P. tridentatus* (Miers) by Holthuis (1952). The holotype of *P. tridentatus* is preserved in the collection of the British Museum (Natural History) and although now in a poor state of preservation, the specimen still has some of the ambulatory pereiopods. These show not only a distinct distal accessory spine on the dactyl but also an acutely pointed proximal ventral spine, which lies between the inner and outer distal ventral spines of the propod (fig. 15, C). On account of the absence of these spines from the dactyls of the ambulatory pereiopods, *P. hecate* (Nobili) is considered a distinct and valid species.

The specimens referred to *P. tridentatus* (Miers) in the material collected by the Siboga Expedition, appear to consist partly of specimens of *P. hecate* or a closely related species, as the characteristic dactyls of the ambulatory pereiopods are illustrated. However, the

minor second pereiopods appear to be of two types and it seems possible that two separate species are present.

Also synonymized with *P. tridentatus* (Miers) were *P. crassipes* (Calman) and *P. quadridentatus* (Rathbun). In the holotype specimens of these species also, the acute proximal tooth on the body of the dactylus of the ambulatory pereiopods is lacking and these are therefore also considered to be distinct from Miers' species. *P. quadridentatus* has well developed distal accessory spines on the dactyls of the ambulatory pereiopods and is therefore considered to be distinct from *P. crassipes* (fig. 15, D).

The type specimens of *P. crassipes* (Calman) need to be re-examined to determine whether the species is a synonym of *P. hecate* (Nobili) or not. In almost all features the two species show a very close resemblance. The most striking feature of *P. crassipes* is the swollen appearence of the propod and carpus of the third pereiopod (fig. 15, D). The propod is about three times longer than the greatest width, which is close to the proximal end, and tapers strongly distally where it is about one quarter of the proximal width. In the minor second pereiopod of *P. crassipes* the fingers are longer and more slender than in *P. hecate*, with large blunt feebly curved tips. The dactylus extends well beyond the tip of the fixed finger and the cutting edge is straight with a series of low blunt teeth. It is provisionally concluded that *P. crassipes* (Calman) is distinct from *P. hecate* (Nobili).

In *P. quadridentatus* (Rathbun) the holotype lacks the minor second pereiopod. The major second pereiopod is remarkably stout with a dactylus bearing a well developed molar process proximally and with the distal half of the cutting edge strongly thickened and rounded. The carpus has the distal dorsal margin produced into a distinct lobe that projects forwards over the proximal part of the palm. This feature has not been noticed in any other species of *Periclimenaeus*. In comparison with *P. crassipes*, and also *P. hecate*, the propod of the third pereiopod is slender and not swollen proximally. The dactyls of the ambulatory pereiopods are without an acute proximal spine but possess well developed, robust, blunt distal accessory spines. It is concluded that *P. quadridentatus* (Rathbun) is also a valid and distinct species.

Balss (1921) referred a single specimen from Cape Jaubert, Western Australia to ? *Coralliocaris hecate*. The dactyls of the ambulatory pereiopods are not described and the specimen needs to be re-examined in order to confirme the identification.

6. **Periclimenaeus nobilii** sp. nov.

Material examined : 1 ♀, coll. Dr. Jousseaume, Red Sea, 1897.

Description

Closely related to *P. hecate* and *P. tridentatus*. The rostrum slightly exceeds the proximal segment of the antennular peduncle and is acute, slender and depressed, with two acute dorsal teeth and a convex toothless ventral margin. Supra-orbital spines or tubercles are lacking. The antennal spine is well developed, slender and acute. The orbit is feebly developed and the inferior orbital angle is obsolescent. The antero-lateral angle of the carapace is slightly produced. The sixth abdominal segment is about 1.5 times longer

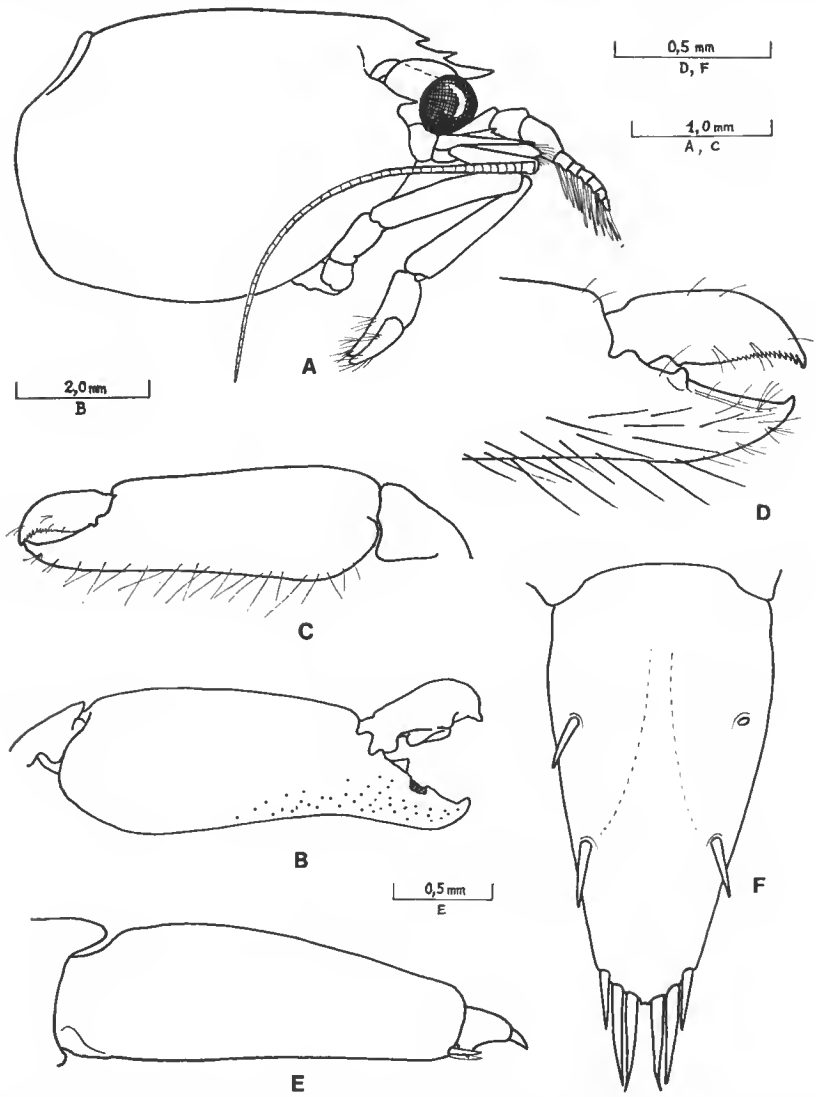

Fig. 14. — *Periclimenaeus nobilii* sp. nov., holotype : A, carapace, antennae and first pereiopod ; B, chela of major second pereiopod ; C, chela of minor second pereiopod ; D, fingers of chela of minor second pereiopod ; E, propod and dactylus of third pereiopod ; F, telson.

than deep. The pleura of the first five segments are rounded. The posterior ventral angle of the sixth segment is bluntly pointed and the posterior lateral angle is rounded. The telson is broad anteriorly, tapering, about twice as long as wide, with two pairs of slender submarginal dorsal spines situated at 0.35 and 0.62 of the telson length. The posterior dorsal spines are slightly longer than the anterior pair and are subequal to the

lateral posterior spines. The intermediate spines are stout, equal to 0.23 of the telson length. The submedian spines are almost as long and stout as the intermediate spines but are more slender distally and are non-setose.

The proximal segment of the antennular peduncle is narrow with a very small disto-lateral process. The stylocerite is short and acute and the lateral border is feebly concave. The intermediate and distal segments are short and stout The basicerite is without a dorsal flange and is unarmed. The carpocerite is slender and exceeds the anterior margin of the scaphocerite, which is broadly rounded and extends well beyond the small disto-lateral spine. The eyes are short and stout, almost globular, with an obliquely hemispherical cornea of slightly smaller width than the stalk.

The first pereiopod is moderately robust, and exceeds the carpocerite by the length of the carpus and chela. The chela is stout with thick fingers that are feebly subspatulate and slightly longer than the palm. The chela is 0.78 of the length of the carpus, which is 4.5 times longer than wide, and increases in size distally. The carpus is 0.91 of the length of the merus.

The second pereiopods are dissimilar and very unequal, smooth. The chela of the major second pereiopod is about three times the post-orbital carapace length. The palm is stout, subcylindrical, slightly flattened and tapering distally, about 2.3 times longer than wide and with a few short simple setae only. The fingers are moderately dorsally curved. The dactylus is 0.37 of the length of the palm and is about 2.5 times longer than wide. A stout hooked tip is present and the anterior cutting edge is thickened. A well developed, distinct molar process is present posteriorly. The fixed finger has a smaller hooked tip present distally with a large fossa proximally. The dorsal margin of the fossa bears a small blunt triangular process and a blunt lobe is present ventrally. The carpus is relatively small and feeble, unarmed and without an anterior dorsal lobe. The ischium is twice as long as wide, tapers gradually distally and is without ventral spines or tubercles. The ischium is about 0.6 of the meral length and is also ventrally unarmed.

The chela of the minor second pereiopod is 0.43 of the length of the major second pereiopod. The palm is subcylindrical and about 2.6 times longer than wide. The ventral median aspect bears numerous long simple setae. The fingers are about 0.4 of the length of the palm. The dactylus is compressed, about 2.6 times longer than wide. The cutting edge is sinuous with about 26 small acute teeth on the anterior two thirds, which increase in size distally and blend without interruption with the small acute hooked tip. The proximal end of the cutting edge also bears a small isolated blunt tooth. The fixed finger is broad, tapering distally to an acute hooked tip. The cutting edge is straight and entire, with a distinct tooth proximally.

Only two ambulatory pereiopods are preserved. The third pereiopod is stout with a small dactylus. The dactylus is compressed, broad at the base and strongly tapering to a distinct acute unguis. There is no distal accessory spine on the body of the unguis but a well developed acute spine is present proximally on the ventral border, where it lies between the two distal ventral spines of the propod. The propod is robust, three times longer than wide and tapering distally. The disto-ventral end bears a pair of stout spines and the rest of the ventral border is devoid of spines. The carpus is 0.7 of the length of the propod, stout, broadest distally, twice as wide as long. The merus is about 1.1 times the length of the propod, uniform in width and unarmed. The (?) fifth pereiopod is simi-

lar, but with more numerous setae along the distal ventral border of the propod. The proximal accessory spine on the dactylus is smaller and more acute than on the third pereiopod.

The uropods present no special features. The protopodite is blunt disto-laterally. The lateral margin of the exopod is entire and terminates in a small acute tooth with a mobile spine medially.

Type : The single female specimen is designated as the holotype and is deposited in the collections of the Muséum national d'Histoire naturelle.

Remarks

The specimen was examined by Nobili in 1905 and tentatively identified as " ? anoma-

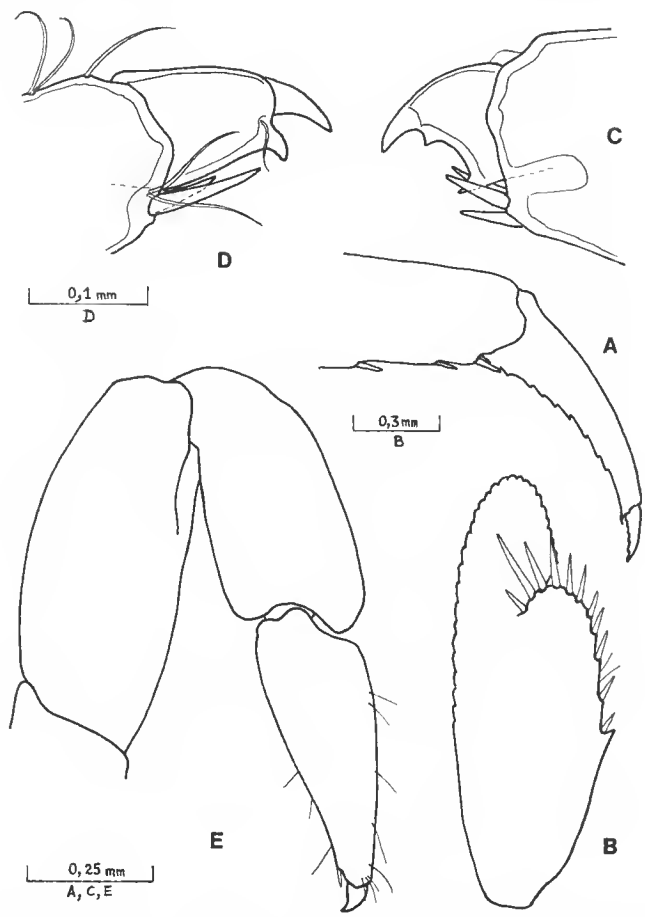

Fig. 15. — *Periclimenaeus arabicus* (Calman), holotype : A, dactyl of third pereiopod. — *Periclimenaeus fimbriatus* Borradaile, type : B, exopod of uropod. — *Periclimenaeus tridentatus* (Miers), holotype : C, dactyl of third pereiopod. — *Periclimenaeus quadridentatus* (Rathbun), holotype : D, dactyl of third pereiopod. — *Periclimenaeus crassipes* (Calman), type : E, third pereiopod.

lie de *Coralliocaris hecate* ". There does not appear to have been any published record of this specimen. As with many of the shrimps collected by M. Jousseaume, the precise locality in the Red Sea was not recorded.

This species is most closely related to *P. tridentatus* (Miers). These two species are the only two species of the genus that possess a proximal accessory spine on the dactyls of the ambulatory pereiopods. The two species may be separated by the absence of a distal accessory spine in *P. nobilii* and its presence in *P. tridentatus*.

7. **Periclimenaeus arabicus** (Calman)

Coralliocaris (*Onycocaris*) *rhodope*, Nobili, 1906 : 49.

Material examined : 1 ♀, Côtes d'Arabie, Stn. XLVII, dragages banc d'huîtres perlières entre 25°10′ N., 24°55′ N. et 55°10′ E., 24°40′ E., Mission J. Bonnier & Ch. Pérez, 1907.

Remarks

The single specimen is macerated and lacks both second pereiopods. The rostrum has six dorsal and one ventral tooth. The supraorbital spines are distinct. The scaphocerite has the lamina subrectangular distally. Both first pereiopods are attached and all the ambulatory pereiopods are present on the right side of the body. The dactyls and the spinulation of the other segments correspond closely to the specimens described above. The telson and uropods are also in agreement.

DISCUSSION

It is now known that most of the Indo-West-Pacific species of the genus *Periclimenaeus* are associated with sponges and that a few are also found in association with compound tunicates. In the case of the specimens reported upon above, none of the hosts were recorded. In order to clarify the relationships of the various species further intact specimens, preferably from carefully identified hosts, are urgently needed. At present it appears that *P. rhodope* and *P. arabicus* are sponge associates but that *P. tridentatus* and its relatives may be associated with tunicates. In the literature there are a number of records of *Periclimenaeus* species being found in association with corals. There appear to be no carefully authenticated instances of such an association and these records have most probably been derived from specimens that have been displaced from small sponges that commonly encrust the base of coral colonies or occur between their branches. Small tunicate colonies can also be found in these situations.

Although a wide variety of sponge hosts appear to be involved in the *Periclimenaeus* association, as yet few generic or specific host identifications are available. The range of variations exhibited by the dactyls of the ambulatory pereiopods indicates a high degree

of adaptation to the host and represents characters of considerable taxonomic value in this genus. In general, these morphological characteristics are best developed on the dactylus of the third pereiopod and shows some reduction of the characteristic features on the fourth and fifth pereiopods. Other features that are of particular importance in assessing the relationships of the various species that are probably direct adaptations to the hosts, are the fingers of the minor second pereiopod and the chela of the first pereiopods. Other characters, such as the rostrum, supraorbital spines or tubercles, the scaphocerite and the major second pereiopod are probably less concerned in adaptation to the host. As yet, the range of variations in many of these characters is unknown, as many of the species are still only known from one or two specimens, which are frequently of different sexes as *Periclimenaeus* species are usually found in pairs. The second pereiopods are also readily autotomized and incomplete specimens often have to be identified mainly on the basis of the dactyls of the ambulatory pereiopods.

The type specimens of *P. djiboutensis* were found in the collections of the Muséum without any indication that they were part of the Djibouti material reported upon by Nobili. In his report Nobili mentions that he has fourteen specimens of *Coralliocaris* (*Onycocaris*) *rhodope*. The material upon which this report is based, included twelve specimens under that name. There seems no reason to doubt that the three type specimens of *P. djiboutensis* were also part of Nobili's material. This gives a total of fifteen instead of fourteen. Although the origin of the discrepancy is uncertain, it is possible that Nobili had an additional specimen that was too incomplete to report upon satisfactorily. In the material at present available the specimen referred to as *Periclimenaeus* sp. seems the most likely specimen as it is the only one that is represented by a single specimen. The present identifications of Nobili's fifteen specimens may be summarized as follows :

P. rhodope (Nobili) 2 ♂, 2 ov. ♀.
P. arabicus (Calman) 2 ♂, 2 ov. ♀.
P. djiboutensis Bruce 1♂, 2 ov. ♀ (present report).
P. djiboutensis Bruce 2 ♂, 1 ov. ♀ (Bruce, 1970).
Periclimenaeus sp. 1 ♂.

To facilitate the separation of *Periclimenaeus tridentatus* (Miers) and related species, the provisional key below is provided. The information concerning several of the species is very limited. Four of the species are known from the holotype specimens only and the other two species are also known only from the two original specimens.

A provisional key to the identification of *P. tridentatus* (Miers) and related species

1. Dactyls of ambulatory pereiopods without accessory spines..... 2
— Dactyls of ambulatory pereiopods with accessory spines..... 3
2. Dactyl of minor second pereiopod much longer than fixed finger, with about ten blunt teeth distally ; carpus and propod of first pereiopod greatly swollen, propod three times broader proximally than distally..... *P. crassipes* (Calman)
— Dactyl of minor second pereiopod subequal to fixed finger with about 40 acute teeth along the whole length of cutting edge ; carpus and propod of third pereiopod less stout and not greatly swollen..... *P. hecate* (Nobili)

3. Dactyls of ambulatory pereiopods without an acute accessory spine proximally..... 4
— Dactyls of ambulatory pereiopods with an acute accessory spine proximally..... 5
4. Rostrum with four acute distal teeth only ; supraorbital tubercles absent, carpus of second major pereiopod with a lobular process disto-dorsally..... *P. quadridentatus* (Rathbun)
— Rostrum with digitiform teeth ; supraorbital tubercles present ; carpus of second major pereiopod without a lobular disto-dorsal process..... *P. pachydentatus* Bruce
5. Body of dactylus of ambulatory pereiopods with a distinct distal accessory spine..... *P. tridentatus* (Miers)
— Body of dactylus of ambulatory pereiopods without a distal accessory spine..... *P. nobilii* sp. nov.

Acknowledgements

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LITERATURE CITED

Balss, H., 1921. — Stomatopoda, Macrura, Paguridea und Galatheidea. Results of Dr. E. Mjöbergs Swedish Scientific Expedition to Australia 1910-13. XXIX. *K. svenska Vetensk.-Akad. Handl.*, **61** (10) : 1-24, fig. 1-12.

Bruce, A. J., 1970. — Further preliminary descriptions of new species of the genus *Periclimenaeus* Borradaile, 1915 (Crustacea, Decapoda Natantia, Pontoniinae). *Zoöl Meded., Leiden*, **44** (21) : 305-315.

Calman, W. T., 1939. — Crustacea : Caridea. *Scient. Rep. John Murray Exped.*, **6** : 183-224, figs 1-8.

Holthuis, L. B., 1952. — The Decapoda of the Siboga Expedition. Part XI. The Palaemonidae collected by the Siboga and Snellius Expeditions with remarks on other species. II. Subfamily Pontoniinae. *Siboga Exped.*, **39** a[10] : 1-252, fig. 1-110, tab. 1.

Nobili, G., 1904. — Diagnoses préliminaires de vingt-huit espèces de Stomatopodes et Décapodes Macroures de la Mer Rouge. *Bull. Mus. natn. Hist. nat. Paris*, 1re sér., **10** : 228-238.

— 1906. — Crustacés Décapodes et Stomatopodes, Mission J. Bonnier et Ch. Pérez (Golfe Persique, 1901). *Bull. scient. Fr. Belg.*, **40** : 13-159, fig. 1-3, pl. 2-7.

— 1906. — Faune carcinologique de la Mer Rouge. Décapodes et Stomatopodes. *Annls Sci. nat.*, Zool., **4** : 1-347, fig. 1-12, pl. 1-11.

Rathbun, M. J., 1906. — The Brachyura and Macrura of the Hawaiian Islands, *Bull. U. S. Fish. Commn*, **23** : 827-930, fig. 1-79, pl. 3-24.

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